

EXECUTIVE SUMMARY

Background

A Preliminary Assessment/Site Inspection (PA/SI) for the Ballfields Parcels located at the Department of Defense Housing Facility (DoDHF), Novato, California, was conducted by the Navy in order to determine whether this property could be readily transferred to the California Coastal Conservancy (CCC) for seasonal wetlands reuse in accordance with the *Hamilton Army Airfield Final Reuse Plan* (Hamilton Local Reuse Authority, 1996). In order to determine suitability for transfer, the property was evaluated through a PA/SI to determine if chemicals in soil and groundwater pose a significant threat to human health or the environment.

The subject site of this report includes Parcels 108A, 110, 112, 114, 115A, and 117 ("Ballfields Parcels") at DoDHF Novato, located approximately 20 miles north of San Francisco in Marin County, CA. In 1932, the U.S. Army Air Corps constructed Hamilton Army Airfield (HAAF) on reclaimed tidal wetland, which had been used as ranch and farm land since the Mexican Land Grant. Military operations began in the area in December 1932. In 1947, HAAF was transferred to the Air Force and renamed Hamilton Air Force Base. The Air Force owned and operated the Base until 1974, at which time it was deactivated. In 1975, residential portions of the Base were transferred to the Navy, and other portions were transferred to the Coast Guard and Army. The Navy used the Ballfields property as a baseball field and open space starting in 1974, until DoDHF Novato (administered by the Navy) was scheduled for closure under the Base Realignment and Closure (BRAC) program in 1994. Prior to the Navy's use of the Ballfields Parcels, the Air Force performed various military functions such as parking aircrafts at revetments for staging and refueling.

A historical documents review of the Ballfields Parcels was conducted and reported in the Background Summary report (Battelle, 2004). Based on this review, a few specific geographical areas within the Ballfields Parcels and the presence of area-wide dichlorodiphenyltrichloroethane (DDT) associated with the former Army BRAC property were identified as potential concerns for further investigation. The geographical areas, designated as areas of potential concern (AOPCs) in this report, were identified as five former airplane revetments, Spoils Pile N (SPN) and Revetment Spoils Pile (RSP) originating from the Perimeter Drainage Ditch (PDD), and two former ordnance magazine buildings (Buildings 191 and 193). As a result of the historical records review, certain hazardous substances in addition to the DDT also were identified as being present or potentially present at some of the AOPCs based on historical activities that occurred at the AOPC. Therefore, as part of the PA/SI, soil and groundwater samples were collected in April 2005 from these AOPCs to confirm or determine the presence of DDT and other hazardous substances. Based on a request from the Department of Fish and Game, the Navy also included the PDD as an AOPC, and collected soil samples from along the top of the banks of the PDD to analyze for DDT and metals.

Soil and groundwater samples were collected in accordance with the site-specific sampling and analysis work plan (Battelle, 2005). Chemical analyses varied by AOPC, but included total petroleum hydrocarbons as gasoline, diesel, and residual range organics (TPH-G, TPH-D, TPH-RRO, respectively); semivolatile organic compounds (SVOCs) (including polycyclic aromatic hydrocarbons [PAHs]); volatile organic compounds (VOCs); explosives, polychlorinated biphenyls (PCBs), and 17 California Administrative Method (CAM) metals. Analytical results varied by AOPC. Generally, low levels of VOCs were sporadically detected across the site, whereas the SVOCs were detected more frequently at low levels, especially in the revetment areas. Metals were commonly detected across the Ballfields Parcels, often at concentrations consistent with background conditions. The presence of DDT was detected in the spoils piles and along the PDD. Only two explosive compounds were tentatively

identified in soil, but at very low levels. Soil samples for PCB analysis were not detected above human or ecological conservative screening criteria and therefore did not warrant further sampling at the Ballfields Parcels.

In order to determine if chemicals present in soil and groundwater pose a significant threat to human health or the environment, both human health screening-level and ecological risk evaluations were conducted. Results of the screening evaluations are summarized in Table ES-1 for risk to human health and ES-2 for ecological risk, and are described below.

Human Health Screening Evaluation

As a conservative measure to assist in making risk-management decisions for the Ballfields Parcels, a hypothetical residential scenario, rather than the actual site recreational visitor scenario, is used to evaluate the risks associated with exposure to chemicals detected in soil and groundwater. Potential risk to human health is evaluated by comparing maximum concentrations detected in soil and groundwater to residential United States Environmental Protection Agency (U.S. EPA) Region 9 Preliminary Remediation Goals (PRGs). In addition, vapor intrusion to indoor air also was evaluated for the hypothetical residential receptor. The screening evaluation was conducted on a site-wide basis, whereby analytical data obtained from each AOPC were combined and evaluated as one dataset. Results of the human health screening-level evaluation, as summarized on Table ES-1, indicate that the estimated total cancer risk and noncancer hazard index (HI) for soil is 5.3×10^{-6} and <1.0 , respectively. Inclusion of the vapor intrusion exposure pathway and the use of the conservative hypothetical residential receptor artificially inflates the cancer risk estimates for the Ballfields Parcels. The risk is inflated because exposure to chemicals in soil would not be expected to be as frequent, or be present over such an extended period of time, for a site recreational visitor as compared to the residential receptor. Given the conservative nature of the screening-level risk assessment, which evaluates the Ballfields Parcels under a hypothetical residential scenario rather than the more appropriate site recreational visitor, the estimated total cancer risk and noncancer HI estimated for exposure to chemicals in soil at the Ballfields Parcels indicate there is no significant threat to human health for the applicable site receptor.

Exposure to groundwater is associated with total cancer risk and noncancer HI of 1.3×10^{-2} and 14, respectively (Table ES-1). It is important to note that these estimates of cancer risk and noncancer HI are the result of the hypothetical residential receptor using the groundwater beneath the site as drinking water. Ingestion of metals (arsenic and vanadium) in groundwater is the primary reason for the elevated risk/hazard estimates. Groundwater beneath the Ballfields Parcels is not suitable for use as drinking water because of high total dissolved solids (TDS), very low recharge rates, minimal saturated aquifer thickness, and the lack of an adequate vadose zone for sanitary well seals. In addition, the low yield and high salinity of groundwater present at the Ballfields Parcels precludes its use for any other beneficial purposes, including agriculture, irrigation, and industrial use. As such, even if a residential housing development were to be constructed on the Ballfields Parcels, groundwater beneath the property would not be used for consumption and the residents would be supplied water from the City of Novato which is the current source of drinking water at the site. Therefore, the only potentially viable exposure route of concern for either the hypothetical resident or the more applicable site recreational visitor is inhalation of chemicals that volatilize from groundwater. However, results of the vapor intrusion pathway indicated that the inhalation route of exposure is not associated with unacceptable risk/hazard (i.e., less than 1×10^{-6} for risk and 1.0 for hazard). Thus, because groundwater will not be used for drinking water, regardless of the type of receptor, the estimates of groundwater risks/hazards presented here overestimate the actual risks associated with the site. Therefore, no significant threat to human health associated with chemicals in groundwater exists at the Ballfields Parcels for the hypothetical resident or the more likely recreational site visitor.

Table ES-1. Summary of Human Health Screening Level Evaluation

Human Health Screening Evaluation Results^(a)			
Soil		Groundwater	
Cancer Risk	Hazard Index^(b)	Cancer Risk	Hazard Index
5×10^{-6}	<1.0	$1 \times 10^{-2(c)}$	14 ^(c)

- (a) Exposure to lead results are not included in the estimates of risk/hazard, but rather directly compared to PRGs. All concentrations detected are less than U.S. EPA Region 9 PRGs.
- (b) The hazard index is the summation of hazard quotients derived for each of the chemicals of potential concern.
- (c) These risks are overestimated for an actual receptor because groundwater is not currently, nor will it likely be used for drinking water or any other beneficial use in the future due to high TDS, low yield, and the fact that the City of Novato already supplies this area with potable water.

Ecological Risk Evaluation

The potential for adverse effects to upper-trophic level receptors resulting from exposure to contaminants in soil was evaluated. A dose assessment was performed using maximum concentrations of chemicals detected in surface soil to determine potential risks. These doses were used to derive two hazard quotients (HQs) for each contaminant of potential ecological concern (COPEC) at the Ballfields Parcels, an HQ_{low} using a low toxicity reference value (TRV), and an HQ_{high} using a high TRV. Results indicated that all of the HQ_{high} for each of the receptors of concern (ROCs) were well below 1.0, but also indicated that some of the HQ_{low} for various metals, Total DDT, 2,6-DNT, and HMX were above 1.0 for various ROC. Therefore, a second dose assessment was conducted to examine the subset of COPECs that were determined to have HQ_{low} above 1.0 in the first dose assessment. For this additional dose modeling, however, 95% UCL soil concentrations were used, rather than maximum soil concentrations (unless the maximum concentration was lower), in order to take into consideration concentration and spatial variability of the chemicals detected in surface soil at the site. Both dose assessments included two low TRVs for the avian receptors for lead: the Navy/BTAG TRV (U.S. EPA, 2002) and the Eco-SSL TRV (U.S. EPA, 2005) as a means to provide a range of risk results for this COPEC. Therefore, two sets of HQs for lead are provided, which are designated by the TRV source [i.e., lead (BTAG) and lead (Eco-SSL)]. In addition to assessing site-related exposure to the COPECs, dose modeling was conducted using background soil concentrations in order to determine the potential risk associated with naturally occurring analytes for risk comparisons. Results of the dose assessments using the 95% UCL soil concentrations and the background soil concentrations are summarized in Table ES-2.

As shown in Table ES-2, risks for the majority of the metals detected during the PA/SI are similar to the risks presented from background concentrations, and the background risk is higher than the risk associated with the 95% UCL soil concentration for antimony, cadmium, chromium, copper, mercury, and zinc. Therefore, because the low TRV HQs were either less than 1.0, or less than the respective low TRV HQ for background concentrations, these six metals are not associated with unacceptable risk at the Ballfields Parcels for any of the ROC. Lead and selenium low TRV HQs for the raccoon are less than or at the threshold criterion of 1 and are therefore, not associated with unacceptable risk for this ROC.

For the vole, lead and selenium are the only COPECs with an HQ_{low} greater than one that also is greater than the background HQ_{low}. For the avian receptors, the HQ_{low} for lead (Eco-SSL) are all below 1.0. For lead (BTAG), risks associated with the 95% UCL are less than twice the risk from background concentrations. Note that there are significant differences between the estimates of risk for lead, at times varying by a factor of 100, depending on the specific TRV (i.e., BTAG vs. Eco-SSL) used to estimate risk. For lead, the majority of concentrations detected in surface soil are below the background

**Table ES-2. Summary of the Ecological Screening Level Evaluation Using
95% UCL Concentrations**

Ecological Risk Evaluation Results			
ROC	COPEC	HQs_{low}^(a)	
		95% UCL Soil Concentration	Background Soil Concentration
Vole	Antimony	0.14	0.20
	Cadmium	3.12	3.87
	Chromium	0.67	0.99
	Copper	1.33	1.77
	Lead	2.06	1.19
	Mercury	1.65	4.86
	Selenium	2.01	1.03
	Silver	0.002	0.0002
	Thallium	0.003	0.04
	Zinc	2.61	2.95
	2,6-DNT	1.03	ND
	HMX	2.16	ND
Robin (50% Worms + 50% Plants)^(b)	Cadmium	1.44	1.93
	Chromium	0.96	1.41
	Copper	0.27	0.46
	Lead (EcoSSL)	0.60	0.31
	Lead (BTAG)	68.9	35.5
	Mercury	0.22	0.66
	Selenium	0.08	0.05
	Zinc	0.59	0.64
	Total DDT	3.81	ND
Robin (100% Worms)^(c)			
	Cadmium	2.62	3.53
	Chromium	1.42	2.09
	Copper	0.33	0.63
	Lead (EcoSSL)	0.92	0.48
	Lead (BTAG)	105	54.3
	Mercury	0.31	0.93
	Selenium	0.12	0.07
	Zinc	1.00	1.08
	Total DDT	7.45	ND
Raccoon	Antimony	0.15	0.21
	Cadmium	2.10	2.81
	Chromium	0.32	0.47
	Copper	0.25	0.43
	Lead	1.05	0.54
	Mercury	0.35	1.04
	Selenium	0.42	0.25
	Silver	0.01	0.001
	Thallium	0.003	0.04
	Zinc	1.15	1.25

Table ES-2. Summary of the Ecological Screening Level Evaluation Using 95% UCL Concentrations (Continued)

Ecological Risk Evaluation Results			
ROC	COPEC	HQ _{low} ^(a)	
		95% UCL Soil Concentration	Background Soil Concentration
Owl			
	Cadmium	1.76	2.32
	Chromium	1.12	1.63
	Copper	0.56	0.79
	Lead (EcoSSL)	0.75	0.43
	Lead (BTAG)	85.6	49.4
	Mercury	0.32	0.94
	Selenium	0.20	0.13
	Silver	NA	NA
	Thallium	NA	NA
	Zinc	0.94	1.01
	Total DDT	7.01	ND
Harrier			
	Cadmium	0.22	0.26
	Chromium	0.59	0.80
	Copper	0.48	0.54
	Lead (EcoSSL)	0.44	0.30
	Lead (BTAG)	50.4	33.7
	Mercury	0.02	0.07
	Selenium	0.18	0.15
	Zinc	0.54	0.55
	Total DDT	6.88	ND

ND – not determined. Shading indicates HQ_{low} > 1.0.

- (a) All HQ_{high} are less than 1.0 for all receptors and were therefore not included on this table.
- (b) assumes only an omnivorous diet for the robin.
- (c) assumes an invertivorous diet for the robin.

concentration of 30.7 mg/kg. Lead concentrations above the 95% UCL soil concentration only were detected in four samples obtained from Revetments 3, 4 and 5, thus showing that the majority of the lead in soil would most likely result in risk consistent with background risk, and depending on which low TRV is used (BTAG vs. Eco-SSL), an HQ_{low} less than 1.0. Based on the low levels of selenium detected at the Ballfields Parcels in conjunction with the fairly representative nature of the concentration distribution, the presence of selenium is most likely naturally occurring and is not anticipated to be associated with unacceptable risk.

For 2,6-DNT, the HQ_{low} is 1.0. For HMX, the HQ_{low} is 2.2. Based on the low magnitude of the HQ_{low}, and the presumptive identification of these two compounds in soil, they are not considered to be of ecological concern at the Ballfields Parcels. As shown in Table ES-2, estimates of risk are above 1.0 for Total DDT. Concentrations of Total DDT in only four surface samples collected from various areas across the site are higher than the 95% UCL soil concentration of 0.12 mg/kg. Concentrations of

the other 11 samples collected from the site are anywhere from one to two orders of magnitude less than the 95% UCL. The low TRV HQs based on the 95% UCL soil concentration range from 4 to 8, depending on the ROC (Table ES-2). Because the majority of the Total DDT concentrations in surface soil are much less than the 95% UCL soil concentration, the estimated risks for the ROCs at the site are more likely less than the conservatively estimated HQs_{low} between 4 and 8. As such, exposure to Total DDT at the Ballfields Parcels is not likely to be associated with unacceptable risk for any of the ROC evaluated.

Potential risk to plants was evaluated by comparing maximum concentrations detected to available conservative screening benchmarks. Total DDT, cobalt, lead, mercury, silver, and zinc, exceeded relevant plant screening benchmarks primarily in the former ordnance magazine areas and Revetments 3 and 4. Exceedances may indicate a potential risk to plant communities; however, observations by various investigators of the existing grassland, including the PA/SI sampling crew, suggest that the cover is complete, and there are not obvious indications of stressed vegetation.

Recommendations

Based on the results of the PA/SI and the low magnitude risk presented to human health and ecological receptors, no further action is recommended for the Ballfields Parcels and it is recommended that the Ballfields Parcels be transferred as is to the CCC for seasonal wetlands reuse. Human ingestion of arsenic and vanadium in groundwater is the main risk driver for the residential scenario that was evaluated. Groundwater beneath the site is not currently used for drinking water or any other beneficial uses and likely will not be used in the future; therefore ingestion of groundwater is not a complete exposure route for the more applicable site recreational visitor, or the hypothetical residential receptor evaluated here as a conservative receptor. As such, actual risk to human receptors is well below the levels that have been estimated in this PA/SI Report and no significant threat to human health is associated with chemicals in soil and groundwater at the Ballfields Parcels. Thus, no further action is recommended.

Based on the results of the ecological assessment, the site risk presented by metals in soils is similar to risks presented by background metals concentrations. Concentrations of Total DDT also are associated with elevated HQs_{low} >1.0 for some of the ROCs. However, all conservative dose estimates were well below effects levels based on high TRVs. Although some of the conservative dose estimates were above 1.0 based on the low TRV, low TRVs derived by the BTAG, U.S. EPA Eco-SSL, ORNL, and USACHPPM process represent a no effect level, whereas the high TRVs represent the mid-range of effects levels found in the literature. There is a critical point on the dose-response curve at which effects will first be seen, but that dose is not known. The difference between the low and high TRVs is typically an order of magnitude, and HQs between 1.0 and 10 give an indication of how close the dose may be to the no effect or low effects levels represented by the TRVs. When the difference between the low and high TRV for a COPEC is very great, there is a high degree of uncertainty regarding where effects may first be seen. The difference between the low and high TRVs is greater than two orders of magnitude for some COPECs, such as avian TRVs for Total DDT and lead. A large difference in the high and low TRV for a COPEC increases the uncertainty of risk conclusions based on the magnitude of the low benchmark HQ because it is unknown whether the dose estimated is approaching where first-effects may be found. Given that low TRVs are generally considered to represent no-effect or "safe" levels of exposure below which no effects are expected, and high TRVs are generally considered to represent effect thresholds above which effects may be expected, the magnitude of low TRV HQs and the level of protection indicated by high TRV HQs do not necessarily indicate unacceptable risk for the COPECs listed above.

Therefore, given the uncertainty associated with the interpretation of the conservative estimates of risk when using the low TRVs for Total DDT and lead at the Ballfields Parcels, no further action is recommended for soil.